

Application of an XML-based Document Framework to Knowledge Content Authoring and Clinical Information System Development

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The role of XML in health care is evolving rapidly. Coupled with other W3C standards, informaticists can design systems that may be used not only for storage and retrieval of structured knowledge, but also for quick transformation of such knowledge into many different usable formats. At Intermountain Health Care, we are currently developing an XML-based document framework to accommodate both the capture of structured knowledge as well as its transformation into several usable formats. Our objective relies upon the premise that information systems can be implemented using workflows based on structured documents.

OVERVIEW

As a precondition to new and highly integrated enterprise-wide clinical information system development within Intermountain Health Care, we are currently involved in developing a robust, scalable knowledge repository for capturing medical knowledge in an encoded and structured format. We have divided the content development process into three main steps: 1) Modeling, 2) Transformation, and 3) Deployment.

CONTENT MODELING

We have been modeling the knowledge content using XML Schema in a highly iterative process. In developing content models for structured documents, careful consideration has been given to the diverse nature of the content, not only in terms of comprehensiveness, structure, granularity, and constraint values, but also in terms of necessary and/or useful details to be used in subsequent data transformations. In addition to XML models for structured content generation, we have also created an XML 'header' schema that captures the metadata of the documents stored in the repository. The header allows documents in several different formats (e.g. XML, PDF, JPEG) to be stored and retrieved in the same way, regardless of whether or not their content is fully structured.

CONTENT TRANSFORMATION

Our experience with XML transformations has shown that well-planned XML schemas can be used

to produce content that is highly versatile. Knowledge content represented in XML can be presented to authors and reviewers in a table-based, largely textual HTML view for easy reading and analysis, whereas clinical end-users can view the same content in a format resembling a form-based graphical user interface. Alternatively, the same content can be transformed into a printer-friendly PDF document. Finally, content that has been both structured and coded according to a controlled terminology can be transformed into a format suitable for integration with decision support systems. As such, a single XML document can serve multiple purposes, including content review, application data, printed material, and executable logic. The flexibility that XSLT affords XML is critical in making the content contained therein highly adaptable.

CONTENT DEPLOYMENT

The first step in implementing our document framework was to write services that interact with a repository of knowledge content. Services were written to access, upload, and version documents within the repository. In addition to the services interacting with the repository, other services were written to communicate with a terminology server. These services allow for content to be encoded using standard controlled terminologies.

As part of our effort to enable authors to generate content in structured format without requiring technical proficiency in XML, we are currently developing a web-based content authoring tool. This tool depends heavily upon the services that communicate with the repository. Within the tool, users create documents in expandable form-like views. In addition, reviewers may access the same documents and provide feedback to the authors. Other applications currently under development will enable clinical users to dynamically create patient-specific orders from standard order sets and guidelines available in the repository.

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